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1889-1929

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A REVISION OF TWO GENERA OF NORTH AMERICAN CERCOPIDAE (HOMOPTERA)

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(Continued from the July issue)

Aphrophora parallela (Say) 1824

As **Ptyelus cribatus**, Walker, List Homoptera British Museum III, p. 712, 1851. Stal. Of. Vet. Akad. Fork. XIX, p. 493, 1862.

Comparative Notes. This species is one of the most distinctive species in the genus. Both male and females are equally distinguishable by the bulbous postclypeus which is inflated to such an extent that it protrudes considerably beyond the frons in dorsal view of head. Moreover, the head is long and conical, extending beyond the eye a distance greater than length of eye from anterior angle to posterior angle and its median length is greater than one-third of greatest width of head, which makes the head proportionally narrower than in other species.

The male genital plates are more similar to **canadensis, punctipes, saratogensis, detritus** and **salicis.** These six species show differences in the relative length of the plates and the eighth and ninth sterna. In **parallela** and **canadensis** the plates are broader than in the other species, with their lateral margins expanded, and the ninth sternum is much longer than either the plates or the eighth sternum. In **parallela** the ninth sternum is not quite twice the median length of the eighth, while in **canadensis** it is more than twice the length of the eighth. In **saratogensis, punctipes** and **salicis** the ninth sternum is shorter than either the plates or the eighth sternum. These five are separated by the fact that the greatest length of the genital plate is at the outer margin in **saratogensis** and **detritus**, the midline in **salicis**, and mesad of midline in **punctipes.** Also that the plates and ninth sternum are sub-equal in **saratogensis** and **detritus**, the plates over twice longer than the ninth sternum in **punctipes**, and the plates about one-third longer in **salicis.** **Saratogensis** and **detritus** are then separated as given in the key to males. A comparison of the drawings will show these differences at a glance.

Distribution and Host Plant Records. In the literature this species is known as the Pine Spittle-bug. Fitch recorded nymphs feeding on pine. Ball (1928) stated that of the species known to him, he believed that this was the only one whose nymphs fed on

pine. Host plants listed have been white pine, **Pinus strolus**, scotch pine, **Pinus sylvestris**, and hemlock (Van Duzee). R. H. Beamer reports collecting adults on **Pinus banksiana**, the gray or northern scrub pine. Say (1824) described this species as **Cercopis parallela** and stated that it inhabited Northwest Territory. A footnote in his description states that it also occurs in Missouri and Arkansas. Ball (1898) pointed out that Say's specimens from these last two places were **irrorata** Ball, which was described in 1898.

Other references are as follows:

Ball (1895). Ontario, New York, Pennsylvania, Vermont, Massachusetts, Maryland, West Virginia, Michigan.

Ball (1934). (North East) from Nova Scotia and Ontario to northern Wisconsin and northeastern Minnesota, south in the Appalachians to Ohio, West Virginia and Maryland. Apparently restricted to pine region around the Great Lakes and the upper part of Appalachian Mountains.

Fitch, Asa (1851). New York as **Lepyronia.** Nymphs on pine.

Glover, (1877). Found on white pine and supposed by the negroes to produce forest flies.

Goding, F. W. (1895). Illinois and Pennsylvania.

Harrington (1889). Ontario, Can.

Harris, J. W. (1862). Massachusetts.

Lintner, J. A. (1889). New York. On white pine.

McAtee, W. L. (1919). Washington, D. C. (Maryland).

Provancher, Leon (1885-1900). Canada.

Smith, John B. (1910). "Throughout state of New Jersey on white and pitch pine and probably infests other species; sometimes not rare."

Stearns (1923). New England states, New York, New Jersey, Ohio, Michigan, Ontario, Wisconsin and Minnesota.

Surface, H. A. (1907). Pennsylvania.

Uhler, P. R. (1885). White pine.

Van Duzee, E. P. (1889). "Common on pines in Muskoka Lake District of Canada."

Van Duzee, E. P. (1894). "Common on pines, Ridgeway, Ontario, in August. Taken everywhere where white pine grows. On hemlock at Lancaster and Colden.

Van Duzee, E. P. (1906). Near Lake Temagami, Ontario.

Van Duzee, E. P. (1908). Quinze Lake, Province of Quebec.

Walker, Francis (1851). As **Ptyelus cribatus.** Nova Scotia.

Wirtner (1904). Erie, Pennsylvania, on pines, in July and August.

The states in which this insect has been collected according to authors are: Connecticut, Illinois, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Nova Scotia, Ohio,

Ontario, Pennsylvania, Quebec, Vermont, West Virginia. Wisconsin. The present writer has studied male specimens only from Connecticut, Michigan, Massachusetts, Maine and Wisconsin; female specimens without males to verify them from Minnesota and Pennsylvania.

Aphrophora quadrinotata Say 1831

As **Aphrophora fascialis** Walker. Walker, Francis, Insects Saundersiana (Homoptera) pp. 1-117, 1858.

Comparative Notes. This is a unique and easily recognized species. It is usually recognized by the presence of two distinct whitish spots on the costal margin of each tegmen and from which it gets its name. The male genital plates are not like those of any other of the North American species.

Distribution Notes and Host Plant Records. Say in the original description stated that this species inhabited the United States. The following records are found:

Ball (1898). This is the most abundant of the eastern species. Ontario, New York, New Hampshire, District of Columbia, Maryland, West Virginia, Georgia, Florida, Iowa and Nebraska.

Barber (1914). Florida.

Fitch (1851). New York, on grapes.

Glover (1876). Maryland, on grapes.

Goding (1895). Pembina, North Dakota (Uhler), Illinois (Forbes).

Lintner (1889). Common in New York.

McAtee (1919). Washington, D. C.

Metcalf (1915). North Carolina.

Osborn (1921). Florida.

Packard (1878). Maine, on grave vines.

Provancher (1885-1900). Canada.

Saunders (1883). Spittle masses on branches of grapes in June.

Smith (1890). New Jersey.

Smith (1910). New Jersey at Newfoundland, Westfield, Staten Island, Orange Mts., Lakehurst and Shark River.

Stearns (1923). New England states, New York, New Jersey, Maryland, Virginia, District of Columbia, Tennessee, Ohio, Ontario, Wisconsin, Minnesota, Iowa and Kansas.

Uhler (1878). North Dakota, Turtle Creek.

Van Duzee (1889). Very abundant Muskoka Lake, District of Canada.

Van Duzee (1894). Buffalo, New York and vicinity.

Van Duzee (1905). Adirondacks. Occasional.

Van Duzee (1908). Quinze Lake, Province of Quebec. Common form.

Van Duzee (1919). Catalogue. Quebec, Ontario, Maine, New Hampshire, Massachusetts, New York, New Jersey, Pennsylvania, Maryland, District of Columbia, North Carolina, Georgia, Florida, Ohio, Illinois, Iowa, North Dakota, Nebraska.

Walley (1928). Connecticut, New York, Ontario and Iowa.

Wirtner (1904). Pennsylvania, Erie, Patton, Greensburg, Pittsburgh.

The writer has seen specimens from the following places: Hamden and Mystic Cave, Connecticut; Cheboygan County, Michigan; Two Harbors, Minnesota; Douglas County, Kansas; St. Paul, North Branch, Eveleth and Shevlin, Minnesota; Vineland, Ontario; Ithaca, New York; Ames, Iowa; Herod, Illinois; Tokio, North Dakota; Schuqualak, Mississippi; Elgin, Alabama; Clarksville, Tennessee; Arlington and Hampshire County, Massachusetts; Fryeburg, Maine; Fish Creek, Wisconsin; and Deepdale, Manitoba.

The summary of the states from which this insect has been collected is: Alabama, Connecticut, Georgia, Florida, Illinois, Iowa, Kansas, Maine, Manitoba, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Ontario, Pennsylvania, Quebec, Tennessee, Virginia, Washington, D. C., West Virginia, and Wisconsin.

The host plants of the species are probably many. Fitch and several others report finding nymphs and adults feeding on grape. Ball (1901) mentions various plants and shrubs and in 1915 stated that it is the common species on grass and low vegetation where spittle masses are often so abundant in meadows as to be a nuisance. Van Duzee (1894) stated that they were common about bushes and weeds, especially deep woods, and Wirtner (1904) found them on small trees and weeds near neglected fields. Richard Schwitzgebel, Kansas State College, found nymphs on **Veronia interior**, ironweed.

Glover, (1876) made the following interesting statement about parasitism: "Insects of the genus are carried off by a Hymenopterous parasite **Gorytis** to provision its nest and serve as food for the young."

Aphrophora saratogensis (Fitch) 1851

As **Ptyelus gelidus**, Walker, List Homop. III, p. 713, 1851. Stal, Of. Vet. Akad, Fork. XIX, p. 493, 1862.

Comparative Notes. Fitch described this species as a **Lepyronia**. In 1856 he pointed out that this is an **Aphrophora** because the ocelli are closer together than to the eyes, which easily separates it from **Ptyelus**, that it has long, narrow wings, an angular notch in the base of their heads, a pale stripe, slightly elevated along middle of head and thorax.

Typical forms are easily recognized by the broad, median white vitta on head and pronotum. Darker specimens have the dorsal vitta almost obsolete as Fitch pointed out and other specimens graduate between the two. These latter variations are confused with **punctipes** and **canadensis** Walley. For a comparison of structure of these three species see the discussion of **punctipes.**

Aphrophora saratogensis is more closely related to **Aphrophora detritus** Walker than other species. In the literature to date **detritus** has been made a synonym of **saratogensis** and the distribution records are consequently somewhat confused. The species can usually be separated by color; **detritus** lacks the broad white head and pronotal stripe of the typical **saratogensis,** has the antero-lateral borders of the vertex light bordered, with about six, small blackish-brown spots, placed at the extreme margin and the elytral punctures have a larger, encircling brown ring.

Structurally they are separated by the median length of vertex, being longer than the lateral margins of the pronotum in **saratogensis,** but equal in **detritus;** by the median length of head being nearly one-half median length of pronotum in **saratogensis,** but much less than half the pronotal length in **detritus;** differences in genitalia are pointed out in the key.

In the terminal abdominal structures of the males **saratogensis** resembles **detritus** Walker, **parallela** (Say), **canadensis** Walley, **punctipes** Walley and **salicis** DeGeer. For a comparison of these structures in the six species, see the discussion under **parallela** and the drawings on page 124.

Distribution and Host Plant Records. The following records are found in the literature:

Ball (1898). Specimens at hand from Ontario, New York, New Hampshire, Washington, D. C., Maryland and West Virginia.

Ball (1928). Adults on pine in Wisconsin, Massachusetts and Virginia. Nymphs never on pine. In Florida nymphs abundantly on ferns beneath the pine.

Ball (1934). Abundant along the Appalachian mountains from Ontario and Nova Scotia to southern Florida, west through Pennsylvania and New York to northern Wisconsin, where it is abundant in the pine barrens, then to Vancouver and California. This range includes **punctipes** and **canadensis** Walley.

Barber (1914). Florida.

Fitch (1851). Adults on pitch pines and white pines on sand plains at Saratoga.

Goding (1895). New York, New Jersey, Ontario, Nova Scotia and Florida.

Metcalf (1915). North Carolina.

McAtee (1919). Vicinity of Washington, D. C.

Osborn (1921). Florida.

Smith (1910). Newfoundland, Staten Island, Jamesburg, Farmingdale, Lakehurst, Malaga and Brown Mills, New Jersey.

Stearns (1923). New England states, New York, Maryland, Washington, D. C., Wisconsin and South Carolina.

Van Duzee (1889). Muskoka Lake, District of Canada.

Van Duzee (1894). Hamburgh, Salamanca and Buffalo, New York. Beaten from pines.

Van Duzee (1906). Lake Temagami, Ontario.

Van Duzee (1909). Florida.

Walker (1851). Florida and Nova Scotia.

The states in which this species has been collected according to authors and which unquestionably are **saratogensis** are: Connecticut, Manitoba, Masachusetts, Michigan, Minnesota, Newfoundland, New Hampshire, New Jersey, New York, Nova Scotia, Ontario and Wisconsin. In the Snow Entomological collection is a large series of male and female specimens, both light and dark, from the following places in Minnesota: Shevlin, Eveleth, Willow Springs, Bena and Itasca Park, all collected as adults on **Pinus banksiana** and Tamarack or the evergreen tree of the North. Males have been identified by the writer from Cheboygan County, Michigan, Manitoba, Illinois, Connecticut and Wisconsin. A large series from Cartwell Cliffs, Ohio is in the Ohio State collection.

Records of states which have been given in the literature, but which probably refer to **detritus** Walker, are Florida, Georgia, Maryland, Mississippi, North Carolina, South Carolina and Washington, D. C.

Present studies seem to show that the southern records given above probably refer to **detritus** Walker instead of **saratogensis.** Recent collecting of large series of specimens in the north indicates that **saratogensis** follows the distribution of **Pinus banksiana** and Tamarack through the northern states. The range of these species is given west and northwest of southern Ohio, Illinois and New York. It is probable that all previous records from southern areas are **detritus** Walker. The latter is not a common species apparently, judging from the few which have shown up in collections, while **saratogensis** is abundant.

Host plants for the adults are pines and Tamarack (larch). Fitch mentioned white and pitch pines, while the large Minnesota series collected by R. H. Beamer, was taken from **Pinus banksianna** (scrub pine) or Tamarack. Dr. Ball (1928) stated that nymphs were never found on pine, but that he had taken them in great abundance on ferns beneath the pines.

Aphrophora signoreti Fitch 1851

Comparative Notes. Superficially resembling **saratogensis** in size, but differing from the typical **saratogensis** by lacking the broad light stripe on head and thorax and by having the lateral margin of vertex between eye and frons much shorter than in the latter. Ball states that it is slightly smaller than **saratogensis** with a shorter, blunter vertex and stronger front. In the key to the female this species runs down close to **salicis** DeGeer, but is separated by having a more rounded instead of the conical head of **salicis**, and by its darker, mottled markings, while **salicis** is uniform tawny.

The male genital plates are more similar to **annulata** Ball than any other species. Here distribution comes into significance, for **annulata** is a limited and rare western species, while **signoreti** is a limited and rare northeastern species. **Signoreti** has the pronotum and lateral margin of the vertex proportionally shorter than in **annulata**. The differences of the male genital plates can more quickly be compared by studying the drawings, the main differences being that in **signoreti** they form fingerlike processes, tapering somewhat at apex, and with the outline of the space between more triangular, whereas in **annulata** the plates are shorter, truncate and darkened at apex, with the outline of the space between them forming a broad arc.

Notes on Distribution and Host Plants. Fitch described the species as a New York insect, feeding on grape, but gave no exact localities. The following records occur in the literature:

Ball (1898). Specimens at hand from New York and Ontario.

Ball (1928). "Species rare in collections. Reported from Ontario, New York and North Carolina. Evidently restricted by Appalachian food plant."

Goding (1895). New York (Fitch).

Lintner (1889). New York. On grapevine.

Metcalf (1915). North Carolina, June 4000-4500 feet.

Saunders (1883). On grape. In book on fruit insects.

Smith (1910). New York and probably New Jersey.

Van Duzee (1908). "A rare species. Providence of Quebec (Quinze Lake Region). I have one specimen taken by Professor Houghton in the Adirondacks and a male by Dr. Brodie at Toronto, Ontario."

Van Duzee (1919). Catalog: New York, North Carolina and Ontario.

Walley (1928). Salamanca, New York and Muskoka, Ontario.

Ball (1934) stated that this is a rare species and that the earlier collected material all came from a restricted district in the peninsular region of Ontario east of Lake Huron. Furthermore, he states, "Miss Doering has recently reported this species from Michigan; an

examination of her material (and that which she reported as **permutata**) gives the following additional records: Huron 8-8-26, Douglas Lake 7-12-30, Cheboygan 7-17-30, all localities along the shore of Lake Huron in the 'Thumb' of Michigan and just across from the region of abundance in Ontario. Miss Doering also records this species from South Dakota, but the material proved to be a female of **irrorata** which is abundant in the Black Hills. The writer has collected in southern and western Michigan and extensively in Wisconsin without finding this species. The known distribution is therefore limited to the peninsula region of Ontario and the opposite shores of Lake Erie or Ontario in New York."

The writer has seen males only from Douglas Lake, Huron and Cheboygan County, Michigan, and Burch River, Manitoba. She still regards the female specimen from Game Lodge, South Dakota as this species instead of **irrorata** and has another dark female from Rocky Mountain Park, Colorado, and one from Itasca Park, Minnesota, which she believes to be this species.

The states given for this species at present are: Ontario, New York, North Carolina, Michigan, South Dakota and possibly Minnesota and Colorado.

Several writers have mentioned nymphs collected from grape. Ball (1934) stated that adults are taken on pine and nymphs from grape.

Aphrophora detritus Walker 1851

As **Aphrophora saratogensis** Fitch.

Ball, E. Entomological News, Vol. XLV: 178, 1934. (In part).
McAtee, W. L. Proc. Biol. Soc. of Wash. 33: 171-176, 1919.
Metcalf, Z. P. Jr. Elisha Mitchell Sci. Soc. XXXI, 1915. (In part).
Osborn, Herbert. Florida Entomologist V: 2-19, 1921.
Van Duzee, E. P. Bul. Buf. Soc. Nat. Sci. IX: 204, 1909.

Comparative Notes. Structurally **detritus** Walker is more similar to **A. saratogensis** Fitch than any other species, having been considered a synonym of that species. For differences between the two see the notes under that species. The writer has not seen the type of **detritus** and as Walker's descriptions are none too distinctive, the establishment of the validity of Walker's species may be questionable. However, since specimens at hand check fairly well in color, structure and distribution, it seems very likely that this was Walker's species.

Description and Host Plant. Since this species has been considered a synonym of **saratogensis** it is difficult to be certain of the past records. Since the host plants of **saratogensis** established in recent years are chiefly **Pinus banksiana** and Tamarack, both common evergreens, living in the cold swamps of the northcentral and northeastern regions of the United States and on north to Labrador,

it seems logical to assume that records south of this area would more likely refer to **detritus** Walker, the type range of which was Florida. On this basis the following state records in the literature are assigned to **detritus**: Florida, Georgia, Maryland, Mississippi, North Carolina, South Carolina and Washington, D. C.

The writer had available for study seven specimens, representing the following localities: Ozone, Arkansas; Erida, Florida; Okefenokee Swamp and Prattsburg, Georgia; Fulton, Mississippi and Walnut, North Carolina. Only one of these was a male, the specimen from Prattsburg, Georgia.

From the scarcity of specimens in collections, it would seem that this is not an abundant species such as **permutata** of the west or **parallela** and **saratogensis** of the northeast.

Aphrophora permutata Uhler 1875

Comparative Notes. A common western species, varying considerably in color from tawny to dark gray-brown, but the males are readily distinguished from other species, except **maculosa** and **fulva** by the long, contingent, finger-like genital plates. In coloring and general appearance it is very difficult to distinguish from **irrorata** Ball, whose male genital plates are broad, short and divergent. Ball, himself, in 1895 stated that **irrorata** resembled **permutata** a great deal and distinguished them by the genital plates and only one other structure, namely that the frons (postclypeus) of **permutata** meets vertex at a right angle, while the frons and vertex forms a slightly acute angle in **irrorata**. Walley (1928) in his key distinguishes them on this basis and on coloring, stating that the elytra are irrorate with dark brown in **irrorata**, but elytra of **permutata** have dark oblique bands. Stearns (1923) states that it closely resembles **irrorata** but can be distinguished by a more inflated front, vertex more narrowly rounded before, the form in general narrower and more sharply angulate behind.

In studying long series of these two species the present writer admits having difficulty in following these differences through the series. In trying to find some more concrete measurable character the only one seemed to be the longer frons of **irrorata**. It was found that the median length of the frons in this species was longer than the median length of the vertex, whereas in **permutata** the median lengths were equal.

Two new species, **maculosa** and **fulva**, which have male genital plates of the **permutata** type, are being described in this paper. The tawny coloring of these two species quite effectively sets them off from the darker **permutata**. For structural differences see the notes in the discussion of these species and in the key.

Distribution and Host Plant. Ball calls this species the common western **Aphrophora**. This seems to be, perhaps, the most abundant

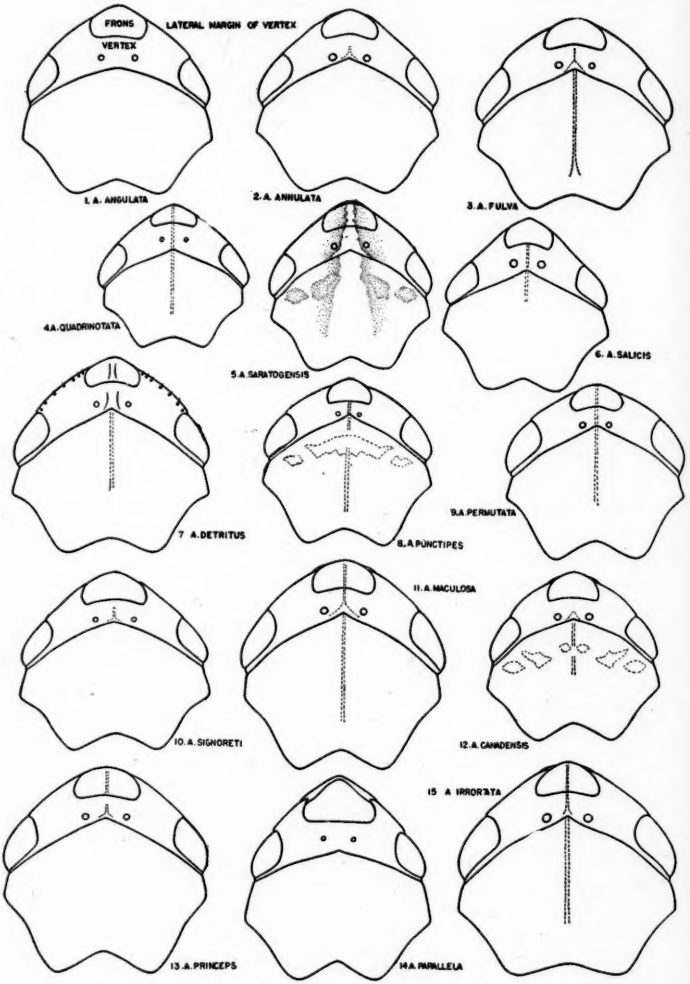
FRONS
VERTEX
LATERAL MARGIN OF VERTEX
1. A. ANGULATA
2. A. ANNULATA
3. A. FULVA
4A. QUADRINOTATA
5 A. SARATOGENSIS
6. A. SALICIS
7 A. DETRITUS
8. A PUNCTIPES
9. A. PERMUTATA
10. A. SIGNORETI
11. A. MACULOSA
12. A. CANADENSIS
13. A. PRINCEPS
14. A. PARALLELA
15 A IRRORATA

PLATE I

Aphrophora in the United States, the Snow Entomological Collection having hundreds of specimens, whereas in other species a couple of dozen seems a long series.

The following records have been given:

Ball (1898). Vancouver's Island, Washington, Oregon, California, Idaho, Montana and Colorado.

Ball (1934). Western mountains—abundant from British Columbia to southern California, east to Montana and Colorado, on pine. Has not been taken south of Utah or Manitou, Colorado, or east of the main range of the Rocky Mountains.

Gillette & Baker (1895). Colorado, Manitou Park.

Goding (1895). Colorado, New Mexico, Utah and California (Uhler).

Stearns (1923). Washington, Oregon, Colorado and Montana.

Uhler (1875). Described from specimens taken in Colorado, Utah and California.

Van Duzee (1919). Catalog. Colorado, New Mexico, Utah, Idaho, Montana, California, Washington and Oregon.

The states in which this insect occurs according to authors are. Colorado, California, Idaho, Montana, New Mexico, Oregon, Utah, Vancouver Island, and Washington.

In the Snow Entomological Collection are matching males and females from many places in California, including very large series from Siskiyou National Forest, Lucerne and Monterey, several places in British Columbia, Haugan and Bozeman, Montana, Sutton, Satus Pass, and Underwood, Washington, Pingree Park, Colorado, and Culver City, Oregon. A large series of specimens in the Oregon State College collection give proof of male specimens from the following places in Oregon: Aberdeen, Bly, Sumpter, Sisters, Pinehurst, Richmond, Lacomb, Prineville, Anthena, Newport, Salem, Milton, Corvallis, Grizzly,

EXPLANATION OF PLATE I

1. Dorsal view of head and pronotum of **Aphrophora angulata** Ball
2. Dorsal view of head and pronotum of **Aphrophora annulata** Ball
3. Dorsal view of head and pronotum of **Aphrophora fulva** n. sp.
4. Dorsal view of head and pronotum of **Aphrophora quadrinotata** Say
5. Dorsal view of head and pronotum of **Aphrophora saratogensis** (Fitch)
6. Dorsal view of head and pronotum of **Aphrophora salicis** DeGeer
7. Dorsal view of head and pronotum of **Aphrophora detritus** Walker
8. Dorsal view of head and pronotum of **Aphrophora punctipes** Walley
9. Dorsal view of head and pronotum of **Aphrophora permutata** Uhler
10. Dorsal view of head and pronotum of **Aphrophora signoreti** Fitch
11. Dorsal view of head and pronotum of **Aphrophora maculosa** n. sp.
12. Dorsal view of head and pronotum of **Aphrophora canadensis** Walley
13. Dorsal view of head and pronotum of **Aphrophora princeps** Walley
14. Dorsal view of head and pronotum of **Aphrophora parallela** (Say)
15. Dorsal view of head and pronotum of **Aphrophora irrorata** Ball

Butte; additional female specimens from Scio, St. Helens, Lava Lake, Hood River, Sparta, Forest Grove, Summitt Prairie and Summit Bly Mountain.

Dr. Ball (1901) gives us our first data on the host plants. He found larvae in abundance on **Chrysopis villosa** and **Lupinus** sp. 'These plants," he states, "grow in clumps and it was down in the base of the clumps that the larvae were found, some of them often below the surface of the ground among the roots. Often ten to 15 would be found in a single clump, their united froth masses held up by the coarse stems, reaching a diameter of two inches or more."

Although both of these plants grow very commonly over a wide extent of territory, the **Aphrophora** larvae have never been found on them except where they are within a short distance of a pine tree.

Dr. Beamer and his collecting party in 1929 observed the feeding of the nymphs of this species in Giant Forest, California. They found abundance of spittle masses on a number of host plants. They collected fully colored specimens by holding a net under the weeds and many nymphs were molting into adults. The nymph crawled out of the spittle mass, anchored itself to a stem, burst skin on dorso-median line and emerged, the process being very similar to the emergence of a cicada.

Aphrophora angulata Ball 1898

Comparative Notes. This species, along with **parallela** and **quadrinotata,** is one of the most easily recognized species in the genus. It is separated easily by its broad tegmina, with ampliate costal margin and two large, although obscure, light spots. Ball (1898) states that it is similar to **quadrinotata,** but is separated by its shorter vertex, larger size and more uniform coloring.

The male genital plates are unique, only possibly being confused with **irrorata** and **princeps.** For differences in these structures, see the key to the males and the drawings.

Distribution and Host Plant Notes. Ball described this species from a single female labeled Cal. collected by Bruner. He stated that he had seen other examples, including one bearing the MSS name **angulata** in Uhler's collection.

Other distribution records are:

Ball (1934). (Pacific Coast) found along the California coast from San Francisco south.

Burmeister (1835). Locality and identification doubtful.

Stearns (1928). San Antonio Canyon, Ontario, Santa Cruz Mts. and Alameda County, California.

Van Duzee (1914). San Diego, Lakeside and Alpine, California. From May to June. Taken on willow.

Van Duzee (1919). Catalog. California.

Walley (1928). San Francisco, California.

In the Snow Insect Collection are specimens from the following places in California: Leona Heights, Sargent, Ventura, Boulder Creek, Stimson Beach, Salinas, San Francisco, Golden Gate, Alpine, Mint Canyon and Monterey. One male from Hoquiam, Washington.

This chiefly California species has therefore been taken in one other state, Washington.

Concerning the host plants Dr. Ball wrote in 1915 that he had taken these insects in certain restricted areas along the coast where adults were collected on willows and in low situations where grasses occur. No spittle masses were ever seen on these trips. Then, another season he accidentally broke off a leaf from the Giant Umbrellifera. **Heracleum lanatum** and discovered that the enlarged sheath was full of froth and that nearly a dozen **Aphrophora** larvae were hidden in the mass. Other sheathes revealed other froth masses ranging from a single larva up to over twenty. A few fresh males were found for identification. Although this weed extends across the continent from coast to coast, the insect occurs only along the California coast.

Aphrophora annulata Ball 1898

Comparative Notes. According to Ball this species is separated from **saratogensis** and **permutata**, which occur in the same range, by its lighter ochraceous-brown color, irregularly maculated with chestnut. Structurally it is separated from **saratogensis** by the median length of vertex, being distinctly longer than lateral margin of pronotum and median length of entire head approximataely one-half median length of pronotum, while in **annulata** the median length of vertex is about equal to pronotal margin and the median length of head is considerably less than one-half median length of pronotum.

The male genital plates more closely resemble those of **signoreti** Fitch than any other species. For comparison of the two see the notes under **signoreti.**

Distribution and Host Plant Records. Ball described the species from 16 specimens taken at Wasatch, Utah. In 1915 he reported the nymphs feeding on **Artemisia ludoviciana** in Utah. In 1934 he gives the following discussion of the insect:

"Western Mountains. Higher elevation in the main range of the Rockies in Colorado and New Mexico, main range Wasatch in Utah, and the main range of the Sierras in California. Stearn's record (1923) of this species from New Hampshire and North Carolina was apparently a mistake, as he has no material in his collection and was not able to refer the writer to material in any other collection. A search of other collections has not revealed any eastern material and Dr. Z. P. Metcalf has no material from North Carolina of Stearn's

determination. Stearn's figure of the male genitalia is not typical of any species and he does not describe the genitalia but quotes the writer's description which he did not do where material was available."

The writer has examined only specimens from the Utah type series, but agrees with Dr. Ball that it is a western species. From Stearn's figure of the male genital plates it seems very probable that the New Hampshire and North Carolina specimens were **signoreti** Fitch.

The states from which this species has been taken without question are: California, Colorado, New Mexico and Utah.

The host plants as given by Ball are adults on pine and nymphs on **Artemisia ludoviciana** or sage.

Aphrophora irrorata Ball, 1898

Comparative Notes. A local western species, usually in size larger than other members of the genus. This species is difficult to distinguish from the abundant western species, **permutata**, except in the male genital plates which fortunately are vastly different. See the discussion concerning these two species in the notes under **permutata.**

The male genital plates are similar to two other species, **angulata** Ball and **princeps** Walley. In fact Ball (1934) considered the latter species to be synonymous with **irrorata**, stating that differences which Walley pointed out were due to a difference in the tilting of the male plates. Differences in the plates of these three specimens are given in the key to the males and can readily be seen at a glance in the drawings. **Princeps** is further distinguished from **irrorata** by its smaller size, longer, narrower pronotum, and shorter head which at middle is a little less than one-fourth total width of head. **Angulata** is easily separated from **irrorata** and **princeps** both by having broad tegmina, with ampliate costa and two large light spots along the costal region.

Dr. Ball in the original description states that it resembles **parallela** closely in color and markings and was probably the one referred to by Say as occurring in Missouri and Arkansas. **Parallela** is readily distinguished by its large, inflated postclypeous and long vertex.

Distribution and Host Plant Records. The following records are found in the literature.

Ball (1898). Described from examples from Sioux County, Nebraska and Ft. Collins, Colorado.

Ball (1934). "Black hills region of Dakota and Nebraska, higher mountain regions of Colorado and Utah and the coast region of British Columbia and Washington, south of Central Arizona and

California mountain regions." This, however, includes **princeps** Walley.

Stearns (1923). Colorado and Nebraska.

Snow (1904). Arizona.

Van Duzee (1903). Beulah, New Mexico.

Van Duzee (1919). Catalog. Nebraska, Colorado, New Mexico, Arizona, California, British Columbia.

Walley (1928). Nebraska, Colorado. He states that Van Duzee's records from California and British Columbia may be **princeps** Walley or **permutata** Uhler.

In the Snow Entomological Collection male specimens are on hand from Little Beaver Creek, Poudre River Canyon, and El Paso County, Colorado; Zion National Park, Utah; Huachuca Mountains, Santa Rita Mountains, Chiracahua Mountains, Granite Dell, and Coconimo County, Arizona; and Cloudcroft, New Mexico. Female specimens only have been collected from southern Arizona, Flagstaff, and Oak Creek Canyon, Arizona; Sargent, California; Magdalena Mountains, New Mexico; Pingree Park, Manitou, and Glenwood Springs, Colorado; Newaygo, Canada.

The unquestioned state records for this species are Arizona, Colorado, Nebraska, New Mexico, South Dakota, and Utah. The California, Canadian and Washington records are still doubtful, since only females have been found, or **princeps** might be included.

In regard to host plants Ball (1934) states that adults have been taken on pine and no nymphs have been observed. The Pingree Park female was taken on aspen, probably accidentally lodged there from a nearby pine.

Aphrophora salicis DeGeer

Comparative Notes. A slender, light colored **Aphrophora**. Body colored and tegmina golden tan with uniform dark brown punctures, no conspicuous light and dark areas. Structurally distinguished by its long, pointed head, its median length being about one-third its width, and its flattened postclypeus which meets the frons at a small acute angle.

The male genital plates are long, roundingly pointed spatulate projections with their lateral margins parallel and not extended fanwise and their apices midway of each lobe. For comparison of the genitalia of similar species see the discussion under **Aphrophora parallela.**

Distribution and Host Plants. This is one of the common species of **Aphrophora** in Europe. According to Metcalf and Barber (1929) it was introduced into the United States or at least was found here in 1921, feeding on various species of willow, **Salix petiolaris, Salix nigra,** in the Arnold Arboretum. These authors made life history studies

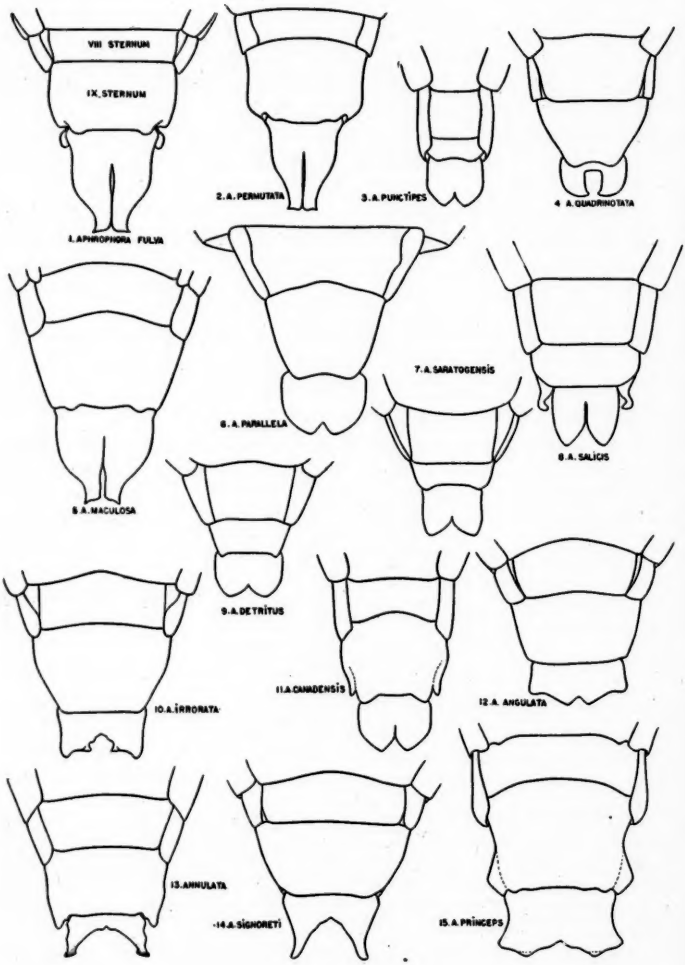
VIII STERNUM
IX. STERNUM
1. APHROPHORA FULVA
2. A. PERMUTATA
3. A. PUNCTIPES
4. A. QUADRINOTATA
5. A. MACULOSA
6. A. PARALLELA
7. A. SARATOGENSIS
8. A. SALICIS
9. A. DETRITUS
10. A. IRRORATA
11. A. CANADENSIS
12. A. ANGULATA
13. ANNULATA
14. A. SIGNORETI
15. A. PRINCEPS

PLATE II

in the summers of 1923 and 1924 and found that the eggs were laid in the terminal twigs of the willow and that the nymphs clustered together while feeding, thus forming large spittle masses.

Aphrophora princeps Walley 1928

Comparative Notes. A small, uniformly dark punctured species, superficially in size and general appearance resembling **punctipes** and **canadensis** Walley. Its male genital plates, however, are more similar to those of **irrorata** and **angulata.** For a comparison with these two species, see the characters in the key to the males and the comparative notes under the discussion of **irrorata.**

It is separated from **punctipes** and **canadensis** by the median length of the head, which is one-fourth the total width of the head in **princeps,** distinctly more than one-fourth in **canadensis** and distinctly less than one-fourth in **punctipes.** In the key to the females this species runs down for some peculiar reason close to **maculosa** and **fulva** which are of the **permutata** type. The latter are easily separated by their tawny, lighter color.

Distribution. Described from holotype male and allotype female, Washington. Walley stated that it occurs in the same locality as **A. permutata** Uhler.

The present studies indicate that it is a far western species but does not have the wide range or occur in such numbers as **permutata.**

The writer has seen male specimens from Fort Seward, California, Victoria, Vancouver, Friday Harbor, Oregon and Hoquiam, Washington.

This species, then, as recorded occurs only in California, Oregon, Vancouver and Washington.

Aphrophora punctipes Walley 1928

Comparative Notes. In 1934 Doctor Ball wrote a brief revision of the genus **Aphrophora** in which he stressed geographical range of

EXPLANATION OF PLATE II

1. Ventral view of male genital plates of **Aphrophora fulva** n. sp.
2. Ventral view of male genital plates of **Aphrophora permutata** Uhler
3. Ventral view of male genital plates of **Aphrophora punctipes** Walley
4. Ventral view of male genital plates of **Aphrophora quadrinotata** Say
5. Ventral view of male genital plates of **Aphrophora maculosa** n. sp.
6. Ventral view of male genital plates of **Aphrophora parallela** (Say)
7. Ventral view of male genital plates of **Aphrophora saratogensis** (Fitch)
8. Ventral view of male genital plates of **Aphrophora salicis** DeGeer
9. Ventral view of male genital plates of **Aphrophora detritus** Walker
10. Ventral view of male genital plates of **Aphrophora irrorata** Ball
11. Ventral view of male genital plates of **Aphrophora canadensis** Walley
12. Ventral view of male genital plates of **Aphrophora angulata** Ball
13. Ventral view of male genital plates of **Aphrophora annulata** Ball
14. Ventral view of male genital plates of **Aphrophora signoreti** Fitch
15. Ventral view of male genital plates of **Aphrophora princeps** Walley

the various species and chiefly because of this placed three species in synonomy, namely **punctipes, canadensis,** and **princeps** described by Walley (1928). He considered **punctipes** and **canadensis** to be synonyms of **saratogensis** Fitch, thus making the range of the latter extended from Florida to Vancouver. The present writer in a synopsis of the North American Cercopidae (1930) had merely accepted Walley's species without question, since little material was available for careful study. Since that time fairly large series have been collected and the validity of Walley's species can be established. It is still true that female specimens of **punctipes, saratogensis** and **canadensis** are not easily separated, but this is also the case with other species in the genus. Typical specimens of **saratogensis** which have the unique broad cream stripe on head and pronotum are easily separated, but darker specimens are found which have this less pronounced or even almost lacking. **Punctipes** and **canadensis** are always dark, uniformly punctured species with only a narrow pale median stripe. Structurally females are separated by the longer vertex of **saratogensis,** which is distinctly longer than the lateral margin of the pronotum, whereas in the other two it is not as long, or only slightly so, and by the median length of the head being approximately one-half median length of pronotum in **saratogensis** and **canadensis,** but considerably less than one-half length in **punctipes.**

Male specimens of the three species are separated by the terminal abdominal structures, which are discussed under the notes concerning **parallela.** In addition, the males are easily distinguished by the following differences in head structures: the width of the frons of **canadensis** is less than twice its median length, in **saratogensis** and **punctipes** it is twice this median length; the median length of the vertex in **saratogensis** is longer than median length of frons, equal in **canadensis,** and less than length of frons in punctipes.

Distribution. Walley described this species from a single male holotype and female allotype taken in Washington. He states that it occurs in the same locality as **permutata** Uhler. Since **permutata** is one of the most common and widely distributed western species, this is somewhat misleading, since the distribution of **punctipes** at the present date is much more limited. Doctor R. H. Beamer collected nine females and eighteen males from Monterey, California, in July and August. This great preponderance of males is unusual for this genus.

Aphrophora canadensis Walley 1928

Ball, 1934, As A. **saratogensis.**

Comparative Notes. In the original description Walley states that it can be readily distinguished from **saratogensis** by the male

genital characters and by the absence of the pale pronotal stripe. From **annulata** and **signoreti** by its longer vertex. It is most closely related, he states, to **punctipes** which has similar male genitalia, but differs in shape and punctuation of the pronotum. This difference in punctuation is difficult to follow from the original descriptions. In regard to the pronotum he states that the posterior margin of **canadensis** is constantly angulate and the median carina obsolete on apical half of pronotum, while **punctipes** the posterior margin is broadly and roundingly emarginate and carina entire.

The present writer finds that **canadensis** is a dark species, fairly uniformly punctate, and is easily confused with **saratogensis** Fitch and **punctipes** Walley. For distinctions in body structure and color see the notes under the discussion of **punctipes.**

In the terminal abdominal structures it resembles **saratogensis, punctipes, parallela** and **salicis.** For a comparison of the differences in these two structures, see the discussion under **parallela** and the drawings.

Distribution. Walley described the species from specimens taken at Victoria, British Columbia. He mentions having fifty-seven specimens on hand.

In the Snow Entomological Collection is a large series of males and females, collected at Monterey, California, one male from Siskiyou National Forest, California, and one female from Goldstream, British Columbia.

Aphrophora fulva n. sp.
Original Description

Size. A medium-sized **Aphrophora.** Length of body, females 11 mm. to 11.88 mm., male 8.8 mm. Greatest width of body across tegmina, female 3.52 mm. to 3.96 mm., male 3.3 mm.

Color. A uniform tawny color, the lightest species in the genus. Head from above uniform tawny, with a narrow, paler median stripe, flanked on each side by a broad, light brown stripe. Thorax stramineous, faintly mottled with darker tones, median carina paler. Tegmina buff background, mottled inconspicuously as follows: a narrow, white oblique band, starting at apex of mesonotum, crossing clavus and corium in a posteriorly direction and ending at about middle of tegmen on R vein, this light streak flanked anteriorly by a broad, irregular dark band; a second narrow transverse light streak extending from apex of clavus to costal border, which again is flanked anteriorly by a dark shaded, irregular band, entire apical portion of corium and a fairly large light spot on mesal border of tegmen just posterior to apex of clavus. Thorax and tegmina with amber-colored pits, centered with a dark dot. Mesonotum and veins mostly stramineous. Under side of body uniform stramineous, inconspicuously shading to dark at border of segments. Claws of legs black.

Structural Characteristics. Head angulately produced beyond eye a distance equal to length of eye or slightly less. Width of head and thorax about equal, full length of head a little more than half its width, its median length less than one-half median length of pronotum and over one-fourth combined length of head and thorax. Frons not protruding, its length equal to median length of vertex. Lateral margin of vertex slightly longer than median length of head, its median length not longer than lateral margin of pronotum or only slightly so. Anterior margin of ocelli and elevated apex of median carina located midway of vertex. Lateral margins of pronotum diverging posteriorly; median carina conspicuous on anterior two-thirds. Mesonotum shallowly depressed through middle. Tegmina narrow, greatest width of clavus three-fifths of corium. Postclypeus not greatly inflated, meeting frons at a distinct acute angle. Male genital plates similar to those of **permutata**, united at base for one-third their length beyond which the outer margin begins to taper, thus constricting the plate just before apex to a narrow apical arm which in width is about one-third of the base.

Comparative Notes. Using the male genital plates as the most accurate character for determination, this species more closely resembles **A. permutata** and **A. maculosa.** It is easily separated from **permutata** by its paler, tawny coloration, the genital plates being much thicker and the ninth sternum proportionally much shorter. From **maculosa** it is separated by its smaller size, longer genital plates which are one-third longer than the ninth sternum in **fulva,** but are equal to the ninth sternum in **maculosa. A. fulva** superficially resembles **A. annulata** although the male plates are distinctly different, as can be seen in the drawings. The females are separated mainly by differences noted in the key.

Distribution and Types. Described from male holotype, and female allotype, seven male and six female paratypes, collected at Kerneville, California by Louis Kuitert, on July 24, 1940; an additional twelve male and twelve female paratypes, same data, collected by R. H. Beamer; one small male, Lucerne, California, by Jack Beamer, July 17, 1935, and another male collected by R. H. Beamer, August 10, 1938. This long series was collected on digger pine, **Pinus sabiniensis.**

Aphrophora maculosa n. sp.

Original Description

Size. A larger **Aphrophora.** Length of body, females 12.32 mm., males 11 mm. to 11.88 mm. Greatest width of body across tegmina, female 4 mm., male 3.52 mm. to 4 mm.

Color. General color golden-brown, mottled with white and fuscous. Frons light brown, with a narrow, white medium stripe. Eyes grey-brown. Vertex with spot on each side of frons, and a nar-

row median stripe light, a brown stripe on each side of carina same color as frons, rest tan with brown flecks. Pronotum stramineous mottled in fuscous and pitted with brown to black punctures. Mesonotum brown with a median stripe and all borders yellow. Tegmina indefinitely mottled, general color being light punctured with very small dark brown pits, each pit surrounded by a light brown ring; the most outstanding markings being a dark V on each tegmen, with its apex located halfway on costal border, one arm ending at the mesonotum and the other at tip of clavus, a dark spot on costal border posterior to the V and a large light area anterior to the V. Under side of body stramineous, abdomen somewhat darker. Tips of genital plates and claws on legs black.

Structural Characteristics. Head angulately produced beyond eye a distance equal to length of eye or slightly less. Head and thorax equal in width. Full length of head a little more than one-half its width, its median length not greatly more than one-third the median length of the pronotum and one-fourth the combined length of head and thorax. Frons, not protruding, its median length equal to median length of vertex. Lateral margin of vertex outwardly rounded, slightly longer than median length of head, its median length equal to or only slightly longer than lateral margin of pronotum. Anterior margin of ocelli and conspicuously elevated apex of median carina located midway of vertex. Lateral margins of pronotum almost parallel; median carina distinct on anterior two-thirds. Tegmina somewhat broader than in some species, greatest width of clavus a little over one-half width of corium. Postclypeus not greatly inflated, meeting frons at a distinct acute angle. Male genital plates similar to those of **permutata** and **fulva**, but differing greatly by being much shorter and thicker, so that combined width of plates at apex is less than width through middle and each plate equal to median length of ninth sternum.

Comparative Notes. For comparison with **A. fulva**, see notes under the description of **fulva**. From **permutata** it is separated by its lighter coloring, its more angulately produced head and the shorter male plates. From **annulata** it is separated by its larger size, greatly elevated median carina of vertex and distinct genital plates (See drawings).

Distribution and Types. Described from male holotype and female allotype and four male paratypes, collected in the San Jacinto Mountains, California, June 30, 1933, by R. H. Beamer.

THE GENUS CLASTOPTERA
(Revised)

1. Few deep pronotal wrinkles or distinct bands, numbering twelve or less on median line, postclypeus generally greatly inflated ----------2

Pronotal wrinkles many, usually numbering sixteen to twenty-five along median line, indistinct or entirely absent in **proteus** group, distinct in others; postclypeus moderately or slightly inflated, **saintcyri** excepted ---------- 11

2(1). Tegmina fuscous brown with a distinct, broad, white band across clavus; wrinkles numbering eleven or twelve along median line ---------- 3

Tegmina without white band; wrinkles or bands less than ten on median line ---------- 4

3(2). Front longer than vertex; size smaller, between 3.5 mm. to 3.7 mm. ---------- **arizonana** Doer.

Front not more than two-thirds length of vertex; size larger, between 4 mm. and 4.5 mm ---- **lawsoni** Doer.

4(2). Mostly black in color ---------- 5

Fuscous and brown, striped and banded in yellow -------- 8

5(4). Black with white spot midway on costal margin; other hyaline or light markings on tegmina and face---- 6

All black above and below; front as long as or longer than vertex; length 4.6 mm. to 4.8 mm. ---- **sierra** Doer.

6(5). Postclypeus black with five or six pairs of light arcs anteriorly; tegmina with apex brownish hyaline and without clear hyaline areas around apical callous; length 3.75 mm. to 4 mm. ---------- **binotata** Ball

Postclyeus without light arcs; smaller, tegmina with more or less clear hyaline areas around apical callous---- 7

7(6). Postclypeus black except for occasionally faint indications on lateral margins ---------- **brunnea** Ball (black male)

Postclypeus with a light band across posterior margin ---------- **lineatocollis** Stal (black male)

8(4). Larger, elongate, measuring 4.5 mm. to 4.9 mm. in length; front usually longer than vertex ---------- 9

Smaller, measuring between 3.4 mm. to 4.3 mm.; front usually not over two-thirds length of vertex ------ 10

9(8). Greenish yellow or sometimes washed in fuscous with white veins in sharp contrast -------- **delicata** Uhler

Bronze, or brownish, with markings more or less obscure on tegmina; arcs and spot on postclypeus more prominent ---------- **lugubris** Ball

10(9). Yellow and light fuscous with prominent yellow veins; postclypeus yellow with light spot or band, preceded by five or six pairs of arcs ---- **lineatocollis** Stal

Darker, with markings less prominent; face mostly all black ---------- **brunnea** Ball

11(1). Face with anterior portion shining black, rest bright yellow; wrinkles shallow or sometimes scarcely discernible ---------- 12

Face uniformly yellow or brown, or anterior portion at least chiefly yellow; wrinkles deep and usually fine ---------- 19

12(11). Body elongate, cell R_5 longer than wide, clavus striped in yellow and black ---------- **salicis** Doer.

Body globose or pear-shaped; cell R_5 about equal in length and width; variously patterned ---------- 13

13(12). Body obovate, tapering at both ends equally; entirely black above ---------- **hyperici** Gib.

Body pear-shaped, widest posterior to middle; black, variously marked above with yellow and brown ---------- 14

14(13). Larger, over 4 mm. in length; pronotum entirely smooth or lines barely visible; dark brown, except occasionally scutellum bright yellow ---------- **globosa** Fowl.

Smaller insects, under 4 mm. in length; wrinkles distinct, although not deep; some yellow or light areas indicated on dorsum or tegmina ---------- 15

15(14). Broad, with tegmina greatly inflated; front approximately equal to length of vertex; black band on postclypeus two-thirds or three-fifths its length ---------- 16

Semi-elongate, pear-shaped, tegmina moderately inflated; front not more than two-thirds length of vertex; black band on postclypeus usually not more than one-half its length ---------- 17

16(15). Yellow and black striped species ---------- **saint-cyri** var. **saint-cyri** Prov.

All black above with brownish-hyaline apex and base of costal area ---------- **saint-cyri** var. **anceps** McAtee

17(16). All yellow or washed in smoky hyaline ---------- **proteus** var. **proteus** Fitch

Mostly black or marked with black ---------- 18

18(17). Base of clavus yellow ---------- **proteus** var. **nigricollis** Fitch

All black above except for yellow bands on head and pronotum and hyaline apex ---------- **proteus** var. **osceola** Ball

19(11). Face entirely yellow or brown ---------- 20

Face yellow, variously marked with dark ---------- 22

20(19). Testaceous yellow, pronotum olive green ---------- 21

Mostly black marked with pale yellow ---------- **testacea** Fitch (male)

21(20). Pronotal wrinkles deep, numerous, very irregular; apical callous light ---------- **osborni** Gill. & Bak.
Pronotal wrinkles less deep, regular, numbering about twenty-five on median line; apical callous dark ---------- **testacea** Fitch

22(19). Pronotal wrinkles irregular, deep; body tapering posteriorly; striking black and yellow species **distincta** Doer.
Pronotal wrinkles regular, moderately deep; body not particularly tapering posteriorly; color pattern varied---23

23(22). Very small, less than 4 mm. in length, **arborina** and **newporta** sometimes excepted ---------- 24
Larger, always 4 mm. or over in length ---------- 29

24(23). Uniformly dark brown or tannish-brown ---------- 25
Fuscous tan with a more or less distinct white band on clavus ---------- 26

25(24). Uniformly dark brown ----------
---------- **xanthocephala** var. **xanthocephala** Germ.
Yellowish brown ---------- **xanthocephala** var. **unicolor** Fowl.

26(24). Usually with two dark spots on vertex and a row of six dark spots on anterior margin of pronotum and sometimes a second row of four spots across disk of pronotum ---------- **laenata** Fowl.
Not such spots present ---------- 27

27(26). More slender with margins of tegmina distinctly parallel; yellow band on pronotum obscure ---- **media** Doer
More robust; yellow band on pronotum very distinct------28

28(27). Smaller, brown bands on pronotum and tegmina very distinct, standing out in sharp contrast; front sometimes longer than vertex ---------- **arborina** Ball
Larger, more robust, more golden in color, with brown markings less prominent, front generally equal to length of vertex ---------- **newporta** Doer.

29(23). Front at least two-thirds length of vertex ---------- 30
Front less than one-half length of vertex ---------- 33

30(29). Fuscous and brown with usually a faint oblique band across clavus and other dark brown marks on tegmina; wrinkles numbering usually between sixteen and twenty ---------- 31
Uniformly pale yellow with no dark markings on tegmina wrinkles numbering approximately twenty-three on median line ---------- **canyonensis** Doer.

31(30). Pronotum entirely yellow; tegmina lighter tan or fuscous with markings and apical veins dark brown in sharp contrast; band on postclypeus and spots on genae smaller ---------- **juniperina** Ball

Pronotum banded with dark; tegmina brownish-fuscous, veins and markings not particularly prominent; band on postclypeus and spots on genae large, occupying central portion of face ----------32

32(31). Pronotum with three brown bands ----------**ovata** Doer.
Pronotum with middle brown band lacking --**siskiyou** Doer.

33(29). Posterior half of face black or sometimes mottled, preceded by five or six pairs of arcs on postclypeus ----------34
Face yellow with a dark band across middle preceded by several pairs of dark arcs ----------36

34(33). Tegmina fuscous brown with an oblique white band across clavus ----------35
Tegmina uniformly bronze fuscous ----------
----------**obtusa** var. **tristis** Van Duz.

35(34). Tegmina very dark fuscous brown with a very distinct white claval band --------**obtusa** var. **borealis** Ball
Tegmina fuscous, mottled, with white claval band much less distinct, sometimes only barely discernible ----------**obtusa** var. **obtusa** Say

36(33). Pronotum uniform yellow without brown markings; no white band indicated on tegmina ----------37
Pronotum yellow with usually two or three brown bands present or at least indicated; a white band across clavus ----------38

37(36). Tegmina light yellow, mottled faintly with fuscous; band and arcs on postclypeus abbreviated at sides ----------**uniformia** Doer.
Tegmina mostly dark fuscous except for anterior portion of clavus, which is bright tawny yellow ----------**achatina** Germar

38(36). Tegmina lighter fuscous tan with markings more distinct; median brown pronotal band broader and more prominent ----------**texana** Doer.
Tegmina dark fuscous brown; median pronotal band narrow, frequently interrupted through middle -------39

39(38). Usually without brown bands on anterior margins of vertex and pronotum; arcs on postclypeus very faint ----------**pallidocephala** Doer.
Brown bands distinct on vertex and pronotum; arcs prominent on postclypeus ----------40

40(39). Brown bands on vertex and pronotum very distinct, never interrupted ----------**tricincta** Doer.
Bands less distinct; median brown band in pronotum often interrupted ----------**elongata** Doer.

Clastoptera globosa Fowler

Fowler, W. W. Rhynchota (Hemiptera-Homoptera).
Biologia Centrali-Americana Vol. II (part I) p. 200, 1894-1909.

Comparative Notes. This species is a large-sized **Clastoptera**, measuring approximately four and one-half millimeters in length. It is readily distinguished by the globose body, being not over one-third longer than its greatest width and its dark brown, shining body. Beyond the clavus the tegmina become light amber in color. Some specimens are striking in color due to a yellow scutellum which contrasts sharply with the dark body. The pronotum is distinctive because it lacks the customary wrinkles or has them only faintly indicated. The corium of the tegmina is inflated behind middle. The postclypeus is greatly inflated, bulb-like, with the anterior half dark brown, rest yellow, and no transverse dark bands, only faint rugosities indicated. Underside of body honey amber in color, legs same with lateral spines and ends of tarsi dark brown.

This species is not readily confused with any United States species. It is very similar in color and structure to C. **funesta** Stal, but differs, as Fowler points out, in size, being approximately four times the bulk of that species.

Distribution. Type localities were Tepetlapa and Chilpancingo, Mexico; San Geronimo, Guatemala. Specimens have recently been taken at Brownsville, Texas. One series was taken by R. H. Beamer on June 29, 1938. Another series by D. J. and J. N. Knull, August 8, 1937. The majority of the former specimens are in the Snow Entomological Collection, University of Kansas, and of the latter in Ohio State University Collection.

THE EXTERNAL ANATOMY OF THE PUPAL ABDOMEN IN DICOSMOECUS ATRIPES HAGEN (TRICHOPTERA, LIMNEPHILIDAE)

ARTHUR L. GOODRICH, Jr.[1]

The specimens used in the preparation of this paper were obtained, as were those utilized in two previous articles[2], from the Big Wood River, Idaho. They were fixed as pupae in Bouin's fluid, and preserved in 70 percent alcohol. Both entire specimens and those macerated in sodium hydroxide were used in the study, with and without the pupal exuviae stripped from the definitive body.

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[1]Contribution No. 220, Department of Zoology, Kansas State College, Manhattan, Kansas.

[2]Goodrich, Arthur L., Jr., The thoracic sclerites of a trichopterous pupa . . . Trans. Amer. Micr. Soc., 54(1): 57-64, 1935.

——— The head capsule of a trichopterous pupa . . . Trans. Amer. Micr. Soc., 56(2): 243-248, 1937.

THE PUPAL EXUVIAE

Female: The exuviae of the abdomen are weakly sclerotized. The heaviest sclerotization is to be found in the tergum of the first abdominal segment, where a dorso-lateral shield bearing a few clusters of setae (fig. 1) replaces the spacing humps of the larval instars. Other abdominal terga are outlined anteriorly and laterally by pigmented areas, but there is little sclerotization (figs. 2 and 3). Further sclerotization of the dorsum is limited to localized areas of "chitinized plates" (Lloyd, 1921) a pair of which is found near the cephalic border of each of the third to seventh terga inclusive (figs. 2 and 3, a.s.p.), with an additional pair near the caudal margin of the fifth segment (fig. 2, p.s.p.). These plates, which more correctly should be described as sclerotized plates, bear backwardly directed denticles or hook-like spines, except those of the caudal pair on the fifth segment, whose denticles are directed cephalad (fig. 2, p.s.p.). There is no constancy in the number of denticles borne by these plates, either for different segments of the same body, corresponding segments of different specimens, or the two sides of the same segment.

Sclerotization is absent from the lateral walls of the abdominal segments, and is limited ventrally to pigmented areas bounding the sternal regions anteriorly and laterally (figs. 3 and 4).

The pupal intestine terminates at the anus, to be found just caudad of the obsolescent segmental groove forming the caudal border of the ninth segment. A pair of prominent sclerotized caudal appendages (figs. 3 and 4, c.a) terminates the exuviae. These caudal processes seem not to house any definitive structure, for no part of the adult body lies within them. The setae borne by the caudal appendages, and upon the last segment, are apparently constant in their arrangement. When the pupal exuviae are stripped from the adult body, a tube-like portion of the pupal hind-gut intima is frequently left protruding from the anal aperture of the imago (figs. 9, 16 and 17, i.i.).

The exuviae bear clusters of finger-like gills, which are usually arranged in a very definite pattern (fig. 5). The clusters have a rather fixed number of filaments, though some variation in numbers occurs. The removal of the pupal exuviae shows that the segments of the imago possess a gill-complement similar to that of the pupa (cf. figs. 5 and 10).

A prominent feature of the exuviae is the presence of the lateral fringes (figs. 3 and 4, l.f) of fine hairs, arising laterally on the fifth segment. Each fringe courses caudalward, dipping ventrally sharply on the eighth segment. The two fringes become approximated on the venter of the eighth segment.

Male. But slight differences are noted between the exuviae of male and female pupae. The areas of sclerotization are duplicated

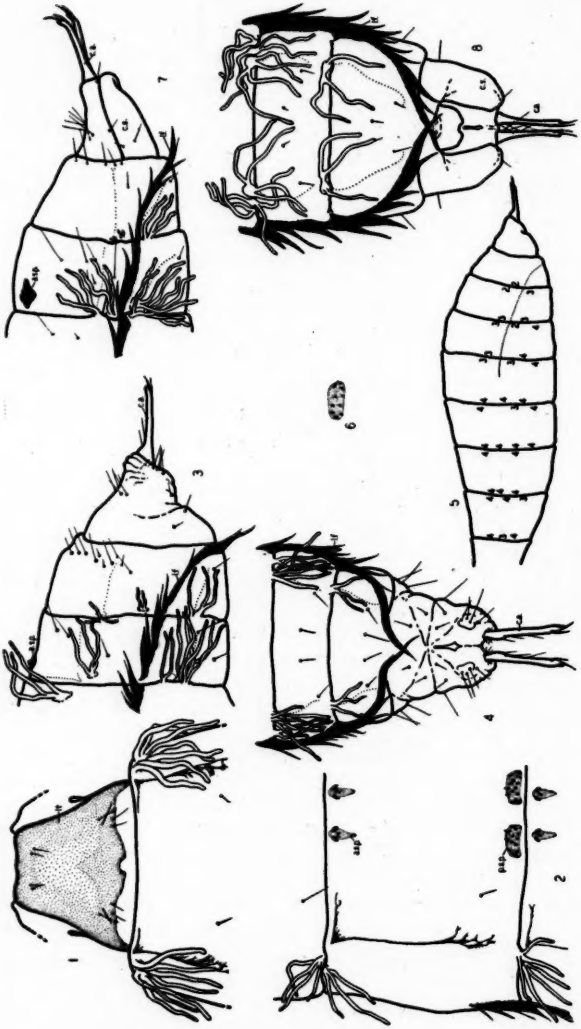

PLATE I

in the two sexes. The caudal pair of sclerotized plates on the fifth segment of the male bears fewer denticles than the corresponding plates on the female (cf. figs. 2, p.s.p and 6). The caudal tip of the male pupa differs from that of the female through the presence of ventro-lateral pouches of cuticula (fig. 7 c.s) which sheathe the claspers of the definitive insect. The male possesses a pair of scerotized caudal appendages (fig. 7, c.a) comparable to those of the female. To all appearances the gill-complement of the male is identical to that of the female.

THE DEFINITIVE EXOSKELETON

Pregenital Segments

Female. The sclerotization of the first abdominal segment is as complex as that of any pregenital segment. The tergum is sclerotized in the form of a dorso-lateral shield. The third phragma of the thoracic mechanism is an integral part of this sclerotization (see Goodrich, Trans. Amer. Micro. Soc., 54(1): 57-64, with figures). The antero-ventral angles of the tergal sclerotization are hinged under the metathoracic epimera (op. cit., fig. 4). The sclerotized portion of the sternum is represented by a pair of very slender ventro-lateral sclerites (loc. cit., figs. 3 and 4). The spiracles of the first abdominal segment are apparently atriate, with the sclerotiza-

EXPLANATION OF FIGURES, PLATE I

Fig. 1. Dorsal aspect, first abdominal segment of pupal **D. atripes.**
Fig. 2. Dorsal aspect, left side of fifth abdominal segment of pupal **D. atripes.**
Fig. 3. Lateral aspect, caudal segments of pupal female of **D. atripes.**
Fig. 4. Ventral aspect, caudal segments of pupal female of **D. atripes.**
Fig. 5. Plan of numbers and distribution of gill filaments, pupa of **D. atripes.**
Fig. 6. Posterior sclerotized plate, fifth segment of male pupa, **D. atripes.**
Fig. 7. Lateral aspect, caudal segments of pupal male of **D. atripes.**
Fig. 8. Ventral aspect, caudal segments of pupal male of **D. atripes.**

TABLE OF ABBREVIATIONS

ae	aedeagus	i	intima, of vesicle
ap	apophysis	i.c	inner cells, of vesicle
a.s.p	anterior sclerotized plate	i.i	intima of intestine
b.c	bursa copulatrix	l.f	lateral fringe
b.p	bridge process	m	muscle
c	circus	ov	oviduct
c.a	caudal appendage	p.p	para-anal process
c.s	sheath of clasper	p.s.p	posterior sclerotized plate
col	collar	s	spiracle
c.p	caudal process	s.c	secretory cells, of vesicle
crp	crypt	s.r	sclerotized ring
cxp	coxopodite	st	sternum
d a.g	duct of accessory gland	set.a	setous area
d.b.c	duct of bursa copulatrix	t	tergum
d.ve	duct of vesicle	t.a	triangular aperture, of aedeagus
d.v.s	duct of vesicula seminalis	tit	titillators
f	flagellum	v	vagina (vestibule)
fl	flange	ve	vesicle
h	harpago	v.s	vesicula seminalis

tion of the anterior and posterior walls of the atria having the appearance of peritremes.

The exoskeleton of the second to eighth abdominal segments inclusive is unvaried by any essential differences except that the sternum of the fifth segment bears two invaginated vesicles. These vesicles will be described subsequently. Each tergum (fig. 9, t) is most heavily sclerotized anteriorly and laterally, corresponding to the lines of pigmentation found in the pupal exuviae. The tergal sclerotization of each segment becomes progressively weaker caudally until unsclerotized cuticula is intucked at the secondary inter-segmental lines.

No pleural sclerotization independent of the sterna is to be noticed in these segments. The spiracles (fig. 10, s) in the lateral fields of these segments are atriate, with the anterior face of each atrium heavily sclerotized. The details of a possible closing mechanism utilizing this sclerotization were undetermined. The sterna (figs. 11 and 12, st) are prominent, yet not heavily strengthened, except anteriorly and laterally, with a supplemental transverse bar of pigmentation near the caudal limits of the sclerotization. The antero-lateral corners of these sterna are noticably invaginated (fig. 12, ap), suggesting that they serve as apophyses for the insertion and origin of muscle elements. As is true of the terga, each sternal area of sclerotization becomes weaker posteriorly.

The vesicular invaginations of the fifth sternum have been analyzed only from a morphological basis. No reference to vesicle-like ventral abdominal glands in Trichoptera has been found in the literature available to me. These vesicles (fig. 12, ve) exist as a pair of elongate, hollow bodies, extending cephalad into the fourth segment from their points of origin near the anterior border of the fifth sternum (fig. 12). Each vesicle is attached to its point of origin near a ventro-lateral angle of the segment by a rather delicate stalk (fig. 14, d.ve). Macerated specimens show the vesicles to be from one-fifth to one-third as long as the segment. Histological preparations of these bodies and their ducts have shown each vesicle lined by a delicate cuticle or intima which is evident also upon maceration (fig. 13, i). The cellular makeup of the walls of the vesicles, as shown in figures 13 and 14, indicates that the epidermal cells have become arranged in two layers. The outer layer is composed of very large cells whose nuclei are prominent and placed rather basally (fig. 13, s.c). The cytoplasm of these cells is somewhat vacuolate, an appearance which might be due to an artifact. It is assumed, however, that these cells represent active glandular cells, and that the vesicle serves as a reservoir for their secretions. The inner layer of cells immediately underlies the intima of the vesicle (figs 13 and 14, i.c). The nuclei are abundant, and quite small. No cell membranes are

evident in the preparations. That these cells secrete the intima of the vesicle is supported by the fact that these cells represent a layer continuous through the duct of the vesicle with the epidermis of the fifth sternum, whose cuticula is continuous with that of the vesicle and its duct (fig. 14, d. ve). Preparations indicate a prominent muscle inserts in the cuticula of each duct (fig. 14, m), suggesting that each duct is closed through the elasticity of its lining, but opened upon the contraction of muscle fibers.

Strikingly similar vesicular abdominal glands are described in the writings of Vosseler (1890) on the odoriferous glands of ear-wigs. Vosseler reports the presence in **Forficula** and **Chelidura** of two pairs of retort-like vesicles, whose contents are released through external apertures opened by the contraction of a muscle. Histologically, the lining of each vesicle is said to be covered by epidermal derivatives of two types. There are numerous small cells, whose outlines are indistinct, and fewer extremely large cells, occurring singly or in clusters on the walls of the vesicles. The essential differences between the cellular components described by Vosseler and those found in **D. atripes** lie in the relative sizes of the large components and in their distribution.

Male. No essential differences are noticed between the exoskeleton of the pregenital segments of the male and female specimens.

Genital Segments

Female. Snodgrass (1933) states that the definitive genital aperture of most female Trichoptera lies caudad of the ninth sternum. The sclerotization of the ninth sternum of the female **D. atripes** is in the form of an elongate, narrow plate, notched anteriorly and caudally (fig. 11, IXst). Ventro-laterally the ninth segment consists of weakly sclerotized areas bearing many setae (figs. 10, set.a). Each side of the ninth segment consists of a heavily sclerotized post-like area (fig. 15, pl). The sclerotization is continued across the dorsum as a less heavily strengthened narrow cross bar, which presumably represents the tergum of this segment.

The tergum of the tenth segment is represented by a triangular plate (fig. 15, Xt) whose base is attached to the sclerotized ninth tergum by a scarcely discernable suture. Caudally, this triangular area is continued as a pair of setiferous flattened caudal processes (fig. 11 and 15, c.p) which overlie and encase the anus laterally.

It is probable that the floor and lateral walls of the tenth segment have been invaginated and form a part of the very extensive ectodermal portions of the female genital tract. In 1904, Stitz summarized the available literature and published upon the genital apparatus of various Trichoptera, giving a brief bibliography of his sources. The present paper adds little to the available information, but substantiates the findings of former investigators. No attempt will be

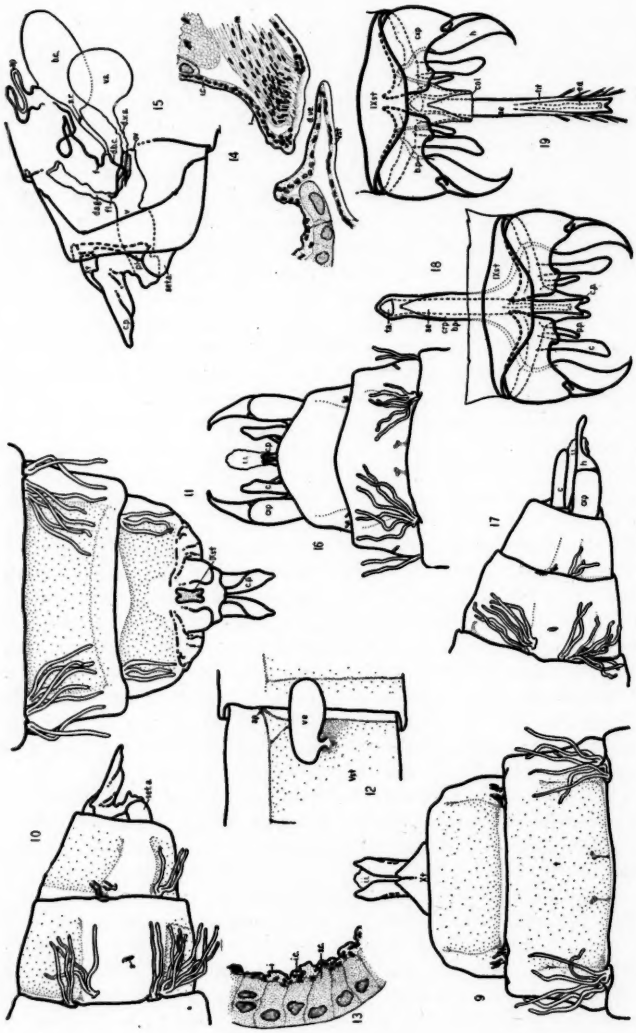

PLATE II

made to treat with the internal genitalia other than as they are represented by the intima left by maceration.

The genital aperture (oviporus) leads into an extensive vagina (vestibule) (fig. 15, v) which courses cephalad well toward the seventh segment. In cross section, the vagina is narrow and vaulted dorsally, broad and flattened ventrally, so that in cross section its dorsal and lateral extension resemble somewhat the three divisions of a clover-leaf. The antero-dorsal portion of the vagina is heavily sclerotized (stippled, in fig. 15). Antero-ventrally the vagina is believed to receive the common oviduct (fig. 15, ov). Immediately above the aperture left by the maceration of the oviduct, and anterior to the region of prominent sclerotization, arises the duct of a vesicle interpreted by Stitz (1904) as the vesicula seminalis (fig. 15, d.v.s and v.s.). The center of the sclerotized area is depressed, the depression being carried caudalward within the vagina as a tapering nipple-like structure. The tip of the nipple is pierced by an aperture leading into an elongate, slender duct (fig. 15, d.b.c) which arises from within the depression. The duct gives off a long flagellum (fig. 15 f) and continues, its lumen enlarging somewhat, ultimately to give rise to an elliptical vesicle considered by Stitz (1904) as a bursa copulatrix (fig. 15, b.c). The widening portion of the duct bears a complete or incomplete ring-like area of sclerotization (fig. 15, s.r), described by Stitz (1904) as "ein kurzer, regelförmigen Abschnitt, der von starkem gelben Chitin ausgekleidet wird und sharf abgegrentz ist." The bursa copulatrix also bears a long slender flagellum which has been termed an appendix (fig. 15, ap). A broad duct, whose walls are thrown into loose elongate folds, arises at the caudal extremity of the heavily sclerotized roof of the vagina. I have never found this duct to terminate in a vesicle, but always to end in a more or less funnel-shaped opening. This structure is considered, according to Stitz (1904), as the duct of the accessory gland (fig. 15, d.a.g). The fact that it exists as an open funnel may mean that in these preparations

EXPLANATION OF FIGURES, PLATE II

Fig. 9. Dorsal aspect, caudal segments of female imago, **D. atripes.**

Fig. 10. Lateral aspect, caudal segments of female imago, **D. atripes.**

Fig. 11. Ventral aspect, caudal segments of female imago, **D. atripes.**

Fig. 12. Ental aspect, ventro-lateral angle of fifth sternum of **D. atripes,** showing glandular vesicle.

Fig. 13. Detail of wall of glandular vesicle, **D. atripes.**

Fig. 14. Detail of duct of glandular vesicle, **D. atripes.**

Fig. 15. Lateral aspect, cuticula of internal genitalia, female of **D. atripes.**

Fig. 16 Dorsal aspect, caudal segments of male imago, **D. atripes.**

Fig. 17. Lateral aspect, caudal segments of male imago, **D. atripes.**

Fig. 18. Detail of sclerotization of genital apparatus of male **D. atripes,** aedeagus inverted. Titillators omitted.

Fig. 19. Detail of sclerotization of genital apparatus of male **D. atripes,** aedeagus everted.

of pupae the formation of this structure has not yet reached its completion. This is substantiated by the fact that much of the intima of the internal genitalia is missing when pigment-free pupae are macerated, while the condition described in the previous paragraphs obtains in pigmented specimens, which are assumed to be more advanced in their metamorphosis.

A striking peculiarity of the strongly sclerotized roof of the vagina is that immediately dorsal to the nipple-like prominence which bears the aperture to the duct of the bursa copulatrix there exists a flange of sclerotized cuticula in somewhat in the form of the front of a toboggan. This flange (fig. 15, fl) extends upward into the duct of the accessory gland and may act as a deflector which serves to guide the copulatory organ of the male to a position over the nipple-like device bearing the aperture to the bursa copulatrix.

Male. It may be accepted that the male genital apparatus of **D. atripes** opens distally to the ninth abdominal somite. The wall of the ninth somite contains a heavily sclerotized ring, telescoped into the caudal portion of the eighth segment. The sternal sclerotization is the broadest portion of the ring (fig. 18, IXst). Laterally the sclerotization exists as two quite slender bands, broadening dorsally. Under the broader dorsum of the ninth segment, two caudal processes (fig. 18, c.p) are inset in the supra-anal region. The weakly sclerotized cuticula connecting these processes to the ninth tergum may be considered to represent the tenth tergum. Such usage is followed in Ross (1938). Thus the caudal processes of the male may be considered homodynamous with those of the female.

The claspers are two segmented: prominent setous coxopodites (figs. 17 and 19, cxp), articulated with the ninth sternum, bear bilaterally symmetrical harpagones (figs. 17 and 18, h) (Snodgrass, 1935). A pons coxalis is not evident. However, the bridge process (BP of fig. 307C Snodgrass, 1935) is probably represented by two bands of sclerotized cuticula (fig. 18, b.p) by means of which the sclerotization of the aedeagus is continuous with that of the mesal face of each coxopodite.

The aedeagus (figs. 18 and 19, ae) is elongate and tubular, and heavily sclerotized. At rest it lies encased for approximately three-fifths of its length within a deep, tubular crypt (fig. 18, crp). The tip of the aedeagus in a macerated preparation may be grasped by forceps and tugged outward to approximate the position it probably assumes when in copulation. Much of the crypt is then everted, the wall of the crypt now forming a collar (fig. 19, col) through which the aedeagus protrudes. The bridge processes (fig. 19, b.p) become twice bent upon themselves upon the extrusion of the aedeagus, as is seen by tracing the contour of the processes in Figure 19. The distal extremity of the aedeagus is truncate and notched or

cleft. The cleft occupies the vertical plane, while the truncate condition extends from a proximo-dorsal position to a disto-ventral point. Thus the aperture of the ejaculatory duct is directed dorsalward and opens through the vertical cleft at the tip of the aedeagus. In macerated specimens the proximal portion of the aedeagus, where the wall of the crypt is continuous with that of the aedeagus, presents a large triangular aperture directed ventrad (fig. 18, t.a). It is assumed that it is by way of this aperture that the vasa deferentia make union with the ejaculatory duct whose intima is evident within the distal portion of the aedeagus (fig. 19, e.d). Ventrally the central portion of the aedeagus gives rise to a pair of symmetrically arranged structures which are interpreted as titillators (fig. 19,tit).

In addition to the caudal processes of the tenth tergum and the prominent claspers, the caudal extremity of the male bears three pairs of processes. These appear not to be articulated to the ninth or tenth segment, but to exist as very prominent hollow evaginations of the integument. The members of the most prominent pair lie laterally to the caudal processes and are termed cerci (fig. 18, c), following the usage of Ross (1938). The least prominent pair lies ventrally to the anal aperture, while the evaginations of median prominence are to be found latero-ventrally to the anal aperture, and are here labelled para-anal processes (fig. 18, p.p).

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